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ABSTRACT

A strategy to identify and address computing needs at a large state university is described that may be used by any university. A task force on instructional computing was formed, and information was gathered concerning: the amount of access and types of computing facilities needed; the issue of standardization of hardware and software; support services (e.g., hardware acquisition and maintenance); and problems of communication and training for students and faculty. Surveys were conducted with students, faculty, and department heads. The department questionnaire covered different types of graphics capabilities and types of computer resources, including: microcomputers, minicomputers, mainframe interactive mode, and mainframe batch mode. Data collection focused on how much access is needed to complete course requirements, excluding student needs for word processing, library searches, and electronic mail. The type and location of student stations that were needed were determined, along with estimated numbers of hours of access required per course. A service unit was generated to represent the theoretical maximum number of hours that a work station can be used. The departments that need their own terminals were identified, and estimates were made of the personnel needed to supervise all work stations. (SW)

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A PLAN FOR STUDENT ACCESS TO INSTRUCTIONAL COMPUTING

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PRECIS

The use of computers in higher education is a dynamic process pushed by the rapidly expanding technology. The proliferation of types of hardware has created a new set of problems related to instruction, cost effectiveness and standardization that must be addressed by university administrations. To further complicate the deliberations, the users have also expanded and diversified.

This paper reports a strategy used to identify and address the computing needs of a large state university. The procedure is relevant for any university which must plan means to greatly expand access to a varied computer environment.

INTRODUCTION

The use of computers in higher education is a dynamic process accelerated by the rapidly expanding technology. No longer does a centralized mainframe represent the dominant system for computer access. A more common environment is one in which mini-micro and mainframes all serve the same users. The proliferation of types of hardware has created a new set of problems related to instruction, research, cost effectiveness and standardization that must be addressed by university administrations. To further complicate the deliberations, the users have also expanded and diversified. Computer users no longer can be identified as those who think in hex and communicate in EDCDIC. People in many non-technical fields are now using computers, and they require a broad range of computer skills from basic literacy to high level programming.

This paper reports a strategy used to identify and address the academic computing needs of a large state university. The procedure is relevant for any university which must plan means to greatly expand access to a varied computing environment. The process began in 1981 with the formation of a task force on instructional computing, and four years later has focused on the implementation of recommendations from the work of the committee. The process included extensive student and faculty surveys of computer related needs followed by the drafting and subsequent funding of a project to address some of those needs. A follow up departmental survey was conducted to assess current and projected requirements for student access to computing for instruction. The particular focus of this paper is on the methodology used to define the needs and obtain and analyze the data that were used to formulate the recommendations of the task force.

The charge to the task force was to study and make recommendations about the University's need to respond to the development of computer technologies for educational purposes. This task force was given the following responsibilities:

1. Conduct an analysis of current practices and procedures related to the use of computers in the instructional process that addresses the type and quantity of student access to computer technology, the extent of faculty awareness of and ability to use the computer in development of their programs, and the inventory of current and projected requirements for computer technology, student awareness and extent of experience with computer technology.

2. Evaluate and make recommendations about the development or revision of curricula in acquiring new technology for instructional programs.

3. Analyze the cost of developing and maintaining software.

The success of this project is directly related to the approach used to gather information that could be used in specific decision making about: the amount of access and types of computing facilities needed, the issue of standardization of hardware and software, the support services such as acquisition of hardware and maintenance, problems of communication and training for students and faculty.

INSTRUMENTS

The selection of members of the task force was designed to include faculty who were knowledgeable about computers and who represented a wide range of disciplines, both technical and non-technical. This committee identified three target groups to survey for information on computer needs: students, faculty, and department chairpersons. Questionnaires were developed, pretested and administered over a two year period.

The student questionnaire provided estimates of the computer background of entering students including their level and source of expertise. The sample included twenty-three class sections selected in a stratified random sample by level (lower division, upper division, and graduate) and by curriculum (technical and non-technical). The questionnaires were administered directly to students except for the individual study sections for which the instruments were mailed to the students. Response rates were high; 315 students (63%) completed the survey. Non respondents were students who happened not to be in class on the day of the administration or who failed to return the mailed questionnaire. All courses and levels sampled were represented in the results.

The faculty questionnaire was designed to survey faculty knowledge of, use of, and attitudes toward computers in education. The questionnaire was a modification of several instruments that had been used at other institutions. It consisted of ten forced choice questions and comments. A random sample of 482 faculty was selected, and the response rate was eighty-six percent. The high percentage of response was due in part to an extensive telephone follow up. The questions concerned the faculty member's use of computers in teaching and in research, the use of original programs versus software packages, types of computers used, desire for learning more about computers, problems in computing, funding for computing, and the relevance of computers for students in the faculty member's academic field.

A Departmental Computing and Hardware Survey was developed and sent to department chairpersons in large colleges and deans in the small colleges. This survey contained six sections that elicited information about currently owned computer equipment, planned purchases, computer support personnel and the instructional uses of computers. A ninety-five percent response rate was obtained.

A final questionnaire was developed and sent to department chairpersons. This survey was designed as a matrix of all courses taught in that department by academic years from 1982 through 1985-86. Enrollments for the base year were entered from the Registrar's computer course files. The chairpersons were asked to estimate the current number of hours of computer access required by students to complete course assignments. Projections for access needs for the years of 1983-84 and 1985-86 were requested. Projected enrollments were estimated for the final year by averaging the current and first year projected enrollments. While this procedure may cause some error, it was decided that the error would likely be more consistent across colleges than would estimates by the chairpersons for three years in the future. This survey also requested that the access needs by the type of computer equipment, i.e. micro, mini, mainframe, and graphics capability be indicated for each course. Seventy-six percent of the 121 departments returned the questionnaire due in some measure to a cover letter from the academic vice president that linked response to funding computer related requests.

The basic question addressed by the task force was, "How much computing is enough?" The traditional approach to this question seldom addresses costs beyond the acquisition of equipment, nor does it base recommendations on an analysis of curriculum requirements. This study projected equipment needs by asking faculty what were the computer related courses needs. It also included the delineation of costs for replacement, maintenance, support personnel, and software. Growth curves for increases in types of computer usage were estimated. The scope of the study was deliberately narrowed to make it a manageable task; it did not address costs of computer networks, or specific funding algorithms for student computing time.

The information collected was limited to how much access is needed to complete course requirements and did not include student needs for word processing, library searches, electronic mail or communication to off campus facilities. It did include the type and location of student stations required. This approach to the problem allowed the survey data on estimated current course access requirements to be compared to previously accumulated data on the amount, type and location of computer equipment currently available. It was a mechanism for assessing where the greatest pressures for access were, and where they were projected to be in the following years. Moreover, the mismatches between the type of equipment available and needed could be evaluated. Shifts from a mainframe environment to minicomputer or microcomputer usage were determined by curricular areas. Changes in batch computing to interactive processing were projected as was the need for computer graphics. This information was used in planning the allocation of resources, the location of computer workstations, the need for centralized and decentralized computing laboratories, and the types of equipment that should be placed in various facilities.

METHODOLOGY

The methodology for analyzing this data and making judgments about the resource requirements is of general interest while specific recommendations are incidental. The questionnaires were all developed by subcommittees of the task force and reviewed by the entire task force. Each document was pilot tested by small relevant groups of people. The format of all but one of the questionnaires was traditional; questions were written as multiple choice, checklists, or open ended response as appropriate. The computer access questionnaire was a matrix of courses by amounts of access needed for three academic years between 1982 and 1985. The instructions asked the respondent to code the type of equipment and the type of access required for each course. Sample questionnaires are included in the Appendix. One questionnaire used an optical scan form; the remainder were coded and keypunched.

The analyses of the three questionnaires on student and faculty use of computers and the inventory of hardware were straight forward. Coding and analyzing the computer access survey are not commonly reported and will be described in detail.

Sample Description. All academic departments and units that grant academic credit at the University were asked to respond to the survey. One hundred and twenty-one departments representing sixteen colleges and two independent units were sent questionnaires. The College of Liberal Arts and Sciences was divided into technical and non-technical departments for coding purposes.

The response rate was ninety-four percent for colleges, and seventy-six percent for departments. Responses represented eighty-three percent of the courses taught and eighty-eight percent of the total student enrollement in the University.

Coding the Data. Four basic types of computer resources were listed in the questionnaire:

Microcomputers
Minicomputers
Mainframe interactive mode
Mainframe batch mode

Because it was possible for a course to require more than one type of computer, respondents were asked to indicate each type students would use. Three additional categories were created from the responses:

Micro/mini-mainframe communication
Mainframe interactive and batch mode
Minicomputer and mainframe communication

Multiple answers to graphics capabilities by courses were also combined by level of resolution and by hard copy with level of resolution. The following categories were coded for the graphics capabilities:

Hard copy graphics
Medium resolution graphics
High resolution graphics
Medium and high resolution graphics
Hard copy and medium resolution graphics
Hard copy, medium and high resolutions graphics

When different types of computer resources were combined for a single course, with different amounts of access for each resource, the highest level of access was coded. For example, if a course required access to both a microcomputer and a mainframe computer with different time requirements in each mode, the course was listed as a multiple resource type that needed the highest amount of access specified for either type of resource.

In order to estimate the number of hours of access required per course, the course enrollment was multiplied by the midpoint of the level of access indicated. For the highest access category, the minimum number of hours (90 per semester) was used to create the hours of student access needed.

Analysis of the Data. The data were analyzed to yield information about six categories of questions. Where necessary the committee derived formulas that could be used to estimate the resource requirements to support and implement the findings of the survey. Each of the analyses is explained below.

What are the projected needs for computer resources?

The results of the survey indicated that sixteen percent of the courses representing eleven percent of the enrollments used computer resources in instruction. This need was analyzed by college with forty-one percent of the courses in Engineering, twenty-seven percent in Agriculture, twenty-two percent

in Business Administration, nineteen percent in Architecture and fourteen percent in the technical departments of Liberal Arts and Sciences. The data yielded enrollment figures that were used to generate the required number of work stations by colleges.

The predicted need for student access in subsequent years indicated a thirty-eight percent increase in the number of computer related courses and one hundred percent increase in the amount of student access time.

What types of computer resources are required?

Approximately forty percent of the anticipated growth was in access to micro-computers, one third of which were intended to communicate with a mainframe. Access to the mainframe interactive mode constituted thirty percent of the growth most of which was in the College of Engineering. Twenty-five percent of the increase was related to terminals that communicated with minicomputers, most of which were to be located in the technical departments of Arts and Sciences and Engineering.

What service units are required?

A service unit was generated that represents the theoretical maximum number of hours that a work station can be used. Based on the number of hours used in a week and fifty weeks a year, three service units were generated. Public access laboratories were typically open sixty hours a week for a total of 3000 hours, and departmental work stations were estimated at thirty hours weekly for a total of 900 hours. The number of hours of access is divided by the service unit to estimate the needed work stations. This estimation does not represent an optimal computing environment and can only be used as a rough approximation for planning purposes. Table 1 shows the projected need for service units by college.

TABLE 1

PROJECTED INCREASE OF SERVICE UNITS
1982-1983 to 1985-1986

College	1982-1983 Total Units Needed	1985-1986 Additional Units Needed	TYPES OF NEW SERVICE UNITS NEEDED						
			Micro	Micro & Others	Mainframe Interactive	Mainframe Int. & Batch	Mainframe Batch	Mini & Mainframe	Mini
Engineering	179	180	23	21	102	*		13	21
Liberal Arts Technical	30	81	15	10	3		3		50
Agriculture	15	21	11	8		*	*		2
Business Administration	36	21	4	6		11			
Journalism	1	15	15		*				
Liberal Arts Non-Technical	*	13	9	4	*	*			
Education	6	9	9	*		*			*
Architecture	7	2	*	*				2	*
Health Related Prof.	2	2	*	2					
Physical Education	*	2	2	*	*				
Medicine	*	*	*	*					
Nursing	*	*		*					
Pharmacy	*	*							
Reserve Officers Training Corps	5								
TOTAL	281	346	88	51	105	11	3	15	73

* Less than one

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What are the requirements for computer graphics?

Service units that are needed for graphics are grouped by the degree of graphics resolution required. From this data, the percentage of graphics workstations needed was computed as follows: Engineering 50%, Liberal Arts and Sciences 21%, Agriculture 7%, Journalism 7%, and Education 4%.

The display of the results of the requirements for computer access was generated from the Statistical Analysis System (SAS) package. Figures 1 and 2 illustrate the computer access needs for the University.

What are the special computing requirements?

Will departmental majors be expected to own their own terminals? These questions were open ended and were used to assist the committee in making recommendations for the allocation of resources.

COMMITTEE RECOMMENDATIONS

Based on the analyses, the committee estimated the current deficits in work stations, suggested a revision to the number of hours used to compute service units and generated the number and types of work stations required. Approximately fifty percent of the work stations would be centrally operated, twenty-five percent would be operated at the college level and twenty-five percent at the departmental level.

The personnel costs for installation at a level of 300 units per year would include a full time Engineer and two assistants. These duties would include planning, arranging for renovation and wiring. Maintenance costs would include another four positions. This estimate assumed that some standardization of equipment would be necessary. One method to accomplish this would be to only provide maintenance service for specific types and makes of equipment. Software support was estimated at another three positions.

The personnel estimates for supervision and consulting were based on 100 work stations which would need a supervisor and seven student consultants.

CONCLUSIONS

The assessment of computer needs is a dynamic process. In four years, four surveys have been completed and two reports were produced. These reports have become planning documents for the University and were an integral part of the system wide plan for the State Universities. A follow up survey of faculty needs is now being planned as part of the ongoing evaulation.

The viability of the process is demonstrated by the continued use of the reports and the need to update the information. The credibility of the reports was directly due to the fact that they were data based. The survey data lent support to the often voiced concern that the entering students had a level of computing skill for which the University facilities and curricula were not adequately prepared. Moreover, faculty at all levels of computer sophistication requested immediate training to keep up with changes in technology related to their instructional and research needs.

To meet these challenges, a joint project with the International Business Machines (IBM) Corporation funded a Faculty Support Center to train faculty in the instructional use of computing. This center offers courses in the use of microcomputers and terminals that communicate with a minicomputer. These courses reflect faculty interest in using the computer as a tool and their disinterest in writing elaborate program code. The currently planned update to the faculty needs survey will be used to evaluate the relevance of course offerings and assess the cost effectiveness of various alternatives to faculty training once the IBM project is completed.

The planning emphasis of the future may well shift from the identification of resource and instructional needs to the management and distribution of computer resources. It is already evident that computer networks in all levels of computers must be integrated in an environment in which word processing is a major activity; interactive computing predominates over batch computing, and micro's must communicate with mainframes and each other. One college (Engineering) is currently developing a plan where every faculty member and student will have unlimited access to a microcomputer. Issues of standardization of technology, type and control of computer access, maintenance of equipment and software, and the delivery of technical advice will become the subject of future studies.